Chapter 14

Asphyxia

"We're drowning in information and starving for knowledge."--- Narendra Yadav

1. General Concept of Asphyxia

The literal meaning of a Greek word *Asphyxia* is 'absence of pulsation" or "death due to deprivation of air." More exact modern terms for lack of air (essentially oxygen) is 'hypoxia' for partial and 'anoxia' for total deprivation.[1]

Asphyxial death of a person results when normal respiration process is obstructed that leads failure in air exchange in between atmosphere and lungs. Thus, asphyxia refers obstruction in breathing system. Asphyxia is a broad and general term because numerous causes and crimes lead to death from asphyxia i.e. deprivation of oxygen.

Asphyxia is defined as inadequate oxygenation of tissue. It is the common endpoint in a variety of deaths in which the cells either fail to receive, or are unable to utilize, oxygen. Because of the innumerable pathways that lead to an asphyxial death, the classification of asphyxia may be broad and varied. Many deaths will not fit neatly into one of the categories below, as more than one asphyxial mechanism may come into play. The brain- although it accounts for only about 2% of the (adult) body weight- utilizes about 20% of the body's oxygen supply, and is therefore particularly susceptible to asphyxia. Even after respiratory arrest has occurred and the brain is irreversibly injured, the healthy heart may continue beating for many minutes.[2]

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[1] Prof. Cederic Keith Simpaon Cbe, Simpaon's Forensic Medicine, 151 (eds. Jason Payne-James et.al. 13th ed. 2011).

2. Symptoms of Asphyxia

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The asphyxial sign may be different in accordance to the type of asphyxia and from case to case. The symptoms are different depending on different forms of asphyxial death such as hanging, strangulation and drowning. Generally, following general signs could be seen as symptoms of asphyxia:

1) Congestion (reddening of skin and tissue above a strangulation mark) and cyanosis,
2) The veins of face, neck region are prominently seen,
3) Eyes may be bulged out,
4) Tongue is usually swollen and blue and is protruded out and usually caught between the teeth.
5) Petechial hemorrhage (Tardieu's spot) in neck, face, eyes. These are round, dark red well-defined spots usually about the size of pinhead and similar but not same to hemorrhage.
6) Bleeding from nostrils and ears due to cerebral congestion (i.e. raised pressure in the veins of brain/ head).

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[2] Andrew Baker, Investigating Asphyxial Deaths (https://www.umc.edu/som/Departments%20and%20Offices/SOM%20Departments/Pediatrics/Divisions/Forensic-Medicine/files/investigating_asphyxial_deaths.pdf Retrived: 2020-09-19)

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3. Causes of Asphyxia

In asphyxia, there will be obstruction of the gas exchange system. The primary cause of asphyxia is cessation of respiratory function of body due to external intervention in breathing system. This intervention could be made through constriction of neck or by closing orifices, or obstructing in air passage by any material, by forceful restriction to the movement of respiratory muscles such as lungs. [3] An example of *Prameshwor Yadav* case[4] is worth discussing where defendant who killed victim by strangling at victim's neck with a plastic rope was held liable for intentional homicide and not on prevocational homicide as defendant was aware and had knowledge or intention that the victim could die of such neck compression. The major causes or modes or manners of asphyxia are:

A) Suffocation

Suffocation refers lack of oxygen in the surrounding gaseous environment. If death results due to absence of adequate oxygen to the body, it is known as suffocation. For example, application of plastic bag to prevent flow of breathing.

Asphyxia may occur where an environment is deprived of oxygen, when the term suffocation is best used, by mechanical asphyxiation and chemical asphyxiation. Mechanical asphyxia includes smothering, plastic bag asphyxia, choking, compression of the neck, traumatic asphyxia, positional/restraint asphyxia, and drowning. Chemical asphyxiants include carbon monoxide, cyanide, and hydrogen sulfide. The postmortem findings may be limited, and the so-called classic signs of asphyxia are absent in asphyxial deaths and present in nonasphyxial deaths. Asphyxial deaths are an important part of Forensic Medicine, but overreliance on nonspecific findings can lead to inappropriate diagnosis.[5]

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[3] Apurba Nandy, Principles of Forensic Medicine Including Toxicology 517 (3rd ed. 2010).

[4] Government of Nepal v. Prameshwor Yadav et.al. 2071 D.N. 9148

Prevention of breathing system by mechanical ways other than constriction of neck or drowning also produces suffocation. Suffocation may occur in various forms such as smothering, chocking, traumatic asphyxia, gagging, burking (mechanical asphyxia where someone sitting on another's chest wall restricts breathing.), overlying (co-sleeping) and inhalation of irrespirable gases.

Generally, following post mortem appearances exist in suffocation:

1. External appearance:
    - Bruises and abrasions on the lips
    - Laceration of inner mucosal surface of lips
    - Nose may be flattened and septum may be fractured.
    - Bruise and abrasions on the cheeks and molar regions as sings of violence.
    - Pale face with eyes open
    - Eyeballs prominent
    - Conjunctiva are congested with petechial hemorrhage
    - Livid lips and tongue may be protruded
    - Bloody froth coming out from mouth and nostrils.

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[5] C.M.Milroy; Asphyctic DeathsOverview and Pathophysiology, 2013 Elsevier (https://www.sciencedirect.com/science/article/pii/B9780123821652001574)

2. Internal appearance:

- Rag, mud, or any other foreign matter may be found in the mouth, throat (pharynx), larynx (voice box), or trachea (windpipe) when suffocation has been caused by choking or gagging.
- Mucous membrane of trachea is usually bright red, covered with bloody forth and congested.
- Lungs are congested and emphysematous.
- Right side of heart is often full of blood (dark), the left empty.
- Blood does not get readily coagulated, hence post mortem wounds may bleed.
- Brain, liver spleen, lungs and kidney generally congested.

Medico Legal Questions in Suffocation

a) Whether death was caused by suffocation?

Sometimes it is not easy to decide because in death due to suffocation, it might show absence of signs of asphyxial death. Rather, resembles to signs present in death from epilepsy[6] tetanus[7] or strychnine poisoning[8] Thus, before reaching to a definite conclusion, it is very essential to look for other evidences of violence. Circumstantial evidences should always be taken into consideration to establish death from suffocation.

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[6] Sudden Unexpected Death in Epilepsy (SUDEP), refers to deaths in people with epilepsy that are not caused by injury, drowning, or other known causes. (Devinsky O. Sudden unexpected death in epilepsy. New Engl J Med. 2011;365:1801-11.) Studies suggest that each year there are about 1.16 cases of SUDEP for every 1,000 people with epilepsy, although estimates vary. (Thurman DJ, Hesdorffer DC, French JA. Sudden unexpected death in epilepsy: Assessing the public health burden. Epilepsia. 2014;55(10):1479-85) Most, but not all, cases of SUDEP occur during or immediately after a seizure. The exact cause is not known, but breathing could be a possible factors. Breathing: A seizure may cause a person to have pauses in breathing (apnea). If these pauses last too long, they can reduce the oxygen in the blood to a life-threatening level. In addition, during a convulsive seizure a person's airway sometimes may get covered or obstructed, leading to suffocation. (https://www.cdc.gov/epilepsy/about/sudep/index.htm Retrieved: 2020-09-17).

b) Whether suffocation was suicidal?

Suicidal suffocation is very rare, though a few cases of suicide among prisoners and insane persons have been recorded. They are said to have stuffed their throats with rags, pieces of blankets, and hay. A few cases of women using a common plastic bag to suicide by trying them over their head and neck have been reported.[9] Suicidal suffocation is very rare due to experience of extreme pain in dying process that compels the suicider to choose other means such as hanging, poisoning or falling from cliff.

c) Whether suffocation was accidental?

Accidental death may be caused in children who cover their head with the bags (plastic or other) while playing. Sometimes children out of curiosity or while playing hide and seek enter inside wooden box or furniture and close from inside and then cannot open leading to accidental suffocation.

Accidental suffocation is very common in case of death of infants, aged person, feeble or drunk person. Death due to suffocation in winter night while sleeping inside enclosed room in heater-on mode or with burning fire, is common form of accidental suffocation in Nepal.

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[7] Tetanus can lead to suffocation or being unable to breathe because of voice box going into spasm/laryngospasm.(https://www.health.gov.au/health-topics/tetanus Retrieved: 2020-09-17)

[8] In strychnine poisoning, death is caused by asphyxia. Since strychnine is rapidly absorbed from the gastrointestinal tract and may cause convulsions with 15 to 60 minutes, the main object of therapy is to prevent or control convulsions and asphyxia.(http://www.inchem.org/documents/pims/chemical/pim507.htm Retrieved: 2020-09-17).

[9] Ashok Kumar v. State; Delhi HC, DD: 24 January, 2014.

d) Whether suffocation was negligent?

In above example of sleeping inside enclosed hotel room in heater-on mode or with burning fire, the hotel owner might be liable for 'causing death by negligence' if hotel owner fails in its duty to adequately inform and warn the customers about the consequence of using heater while sleeping at night. However, it is to be noted that where there is no law, there can be no duty.

Workers who have gone below to clean or repair too deep wells might suffer suffocation due to reduced oxygen. Likewise, mountain climbers or high altitude flights might cause suffocation due to reduced oxygen at high altitude. The employer or trekking and mountaineering company or airlines company might be liable for 'causing death by negligence' if it is established that death resulted from suffocation because of violation of legal duty to take reasonable care of such worker/climber/passenger. Where there is no law there is no duty. This duty could be duty to take adequate safety measures and precautions (including arrangement for timely oxygen access).

e) Whether suffocation was due to recklessness?

In above exemplary instances, where the employer or trekking and mountaineering company or airlines company foresees the possibility of death due to suffocation, yet operate their service without taking any precautions believing that they will be able to avoid the consequence, such employer or trekking and mountaineering company or airlines company are liable for causing death by recklessness, in case the person dies of suffocation. This is more relevant when cabin crew, flight attendants who being primarily responsible for passenger's safety and comfort take unreasonable risk of not providing needy support to patient customers having asthma or respiratory disorder.

f) Whether suffocation was homicidal?

Homicidal suffocation is common usually in infants and children. Even weak and feeble adults who are unable to resist under intoxication or influence of narcotic drugs are its victim. Homicidal suffocation in case of adults is often combined with smothering or throttling. Homicidal suffocation is common, and is usually resorted to in murdering infants and children by forcing mud down their throats, or by smothering them by the hands, clothes, and soft pillows.

In case of homicidal asphyxia, presence of fine dust in the esophagus and stomach is a sure proof of a person being buried alive. In burial after death, fine dust may be found in the upper air passages but not in the esophagus or stomach.

Homicidal suffocation is more commonly practiced to take life of infants, aged person, and helpless person due to their physical disability or artificial helplessness. In newly born children it could be done easily and may leave behind no characteristic traces.

B) Smothering

Smothering is mechanical obstruction of the nose and mouth and this could be accidental,[10] homicidal,[11] or suicidal.[12]

Many things are capable of smothering: hands, clothes, pillows, plastic bags, gags, or falling into sand, grain, sawdust, etc.[13]

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[10] E.g.- wedging and overlay deaths of small children (note that there is also a component of mechanical asphyxia here)

[11] Examples- intentionally placing a hand or pillow over the nose and mouth; covering a victim's nose and mouth with tape.

[12] E.g.- placing a plastic bag over the head (plastic bag suicides are very difficult to diagnose if the bag is removed before medical examiner/investigator is made aware).

[13] Andrew Baker, Investigating Asphyxial Deaths (https://www.umc.edu/som/Departments%20and%20Offices/SOM%20Departments/Pediatrics/Divisions/Forrensic-Medicine/files/investigating_asphyxial_deaths.pdf Retrieved: 2020-09-19)

Smothering is a cause to lead asphyxia through blockage of the external breathing orifices i.e. mouth and nostrils. It is a form of asphyxia caused by mechanical occlusion of external air passages, viz. the nose and mouth by hand, cloth, plastic bag duct tape or other such material.[14]

Smothering is a form of asphyxia caused by closing external respiratory orifices either by hand or other means or by blocking up cavities of nose and mouth. Homicidal smothering can take place by closing the mouth or nose by hand or cloth or if the face is pressed into a pillow, etc. When obstruction is caused by bed clothing, pillow, cushion etc., it may or may not leave any external signs of violence except signs of asphyxia. When the face is pressed by a pillow, the skin around the nose and mouth may appear to be pale or white due to pressure. Saliva, blood and tissue cells may be found on the pillow and in case orifices are closed by hand, there may be scratches or nail marks or laceration of the soft parts of the face. Lips, gums and tongue may show bruising of laceration and slight bruising may be found in the mouth and nose. Blood may have oozed from the mouth or nose and the tongue may have protruded. Blood stained froth is present in air-passages. Homicidal smothering is difficult to detect and autopsy may reveal asphyxia, but the said evidence should be collated and corroborated by signs of violence or injuries on the face or nose.[15] This is very important and significant to be noticed.

Medico-legal importance

a) Homicidal smothering: When anyone intentionally obstructs someone's external orifices leading to the death of person is known as homicidal smothering. Application of pressure on face and nose of a person through hand or any other objects such as pillow, blanket etc. or pressing the face in mud or land could lead smothering.

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[14] Nageshkumar G Rao, Textbook of Forensic Medicine and Toxicology, 209 (2ed ed. 2010).

[15] Ashok Kumar v. State; Delhi HC, DD: 24 January, 2014.

The most common methods of infanticide are smothering, strangulation, and head injury. The face and neck should be carefully inspected in search of injuries, bruises, and/or ligature marks.[16]

Particularly in very young children who are smothered (accidentally or otherwise), there often are no findings at autopsy. Homicidal smothering of adults may be associated with bruising around the mouth, nose, chin, cheeks, or neck. Bruises or lacerations inside lips should be looked for.

b) Accidental smothering: New born babies, helpless aged person, unconscious or heavily intoxicated person could be the victim of accidental smothering. For instance, an intoxicated person lying in prone position in mud may die due to blockage in orifices. Children may playfully cover their head and mouth with plastic bag and may not be able to remove such due to unconsciousness or inability. A fetus may have the umbilical cord tied around its own neck when inside the uterus, resulting in accidental smothering.

c) Suicidal smothering: Suicidal smothering is very rare due to experience of extreme pain. Application of hard pillow or plastic bag covering the head with more knots is some way to commit suicide by smothering. Smothering is an uncommon cause of suicide and is particularly observed in psychiatric patient.[17] Suicidal death is to be established by the study of circumstances and autopsy finding.

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[16] Marta C. Cohen and Irene Scheimberg; Forensic Aspects of Perinatal Deaths; Acad Forensic Pathol. 2018 Sep; 8(3): 452–491.Published online 2018 Aug 31. (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6490584/)

[17] Nidhal Haj Salem et.al.; An unusual case of smothering by a medical nebulizer, Forensic Leg Med; 2013 Jul;20(5):537-9. doi: 10.1016/j.jflm.2013.02.006. Epub 2013 Feb 28. (https://pubmed.ncbi.nlm.nih.gov/23756529/)

Post mortem appearance

External appearance:

- Bruises and abrasion on lips, checks and molar region because of forcible application of hand over the mouth and nostrils.
- Inner muscular surface of lip may be lacerated from pressure on teeth.
- Nose may be flattened and its septum may be fractured.
- Local signs of violence and of struggle may be found.
- Depression and bleeding from nose may be seen.
- Body may show struggle signs in other parts.

These external appearances may differ in accordance to the circumstances of smothering such as accidental, homicidal and suicidal.

Internal appearances:

- In case of smothering due to falling in mud, flour like substance or grain particles, such objects could be detected in respiratory tract or lungs of the deceased.

Other internal signs such as dark blood fluid, congestion of organs, lung etc. are detected which indicate general signs of asphyxia.

C. Chocking

Choking refers the obstruction of air passage from inside. It is blocking of the internal airways. It may be due to presence of foreign bodies such as potato peel, plastic plug, pieces of button, coin mud, artificial teeth etc. which obstructs breathing system. There is no need of definite size of the object to cause laryngeal spasm. Gagging is the cause of chocking due to presence of some

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substance i.e. blockage of the internal air passages. Generally, chocking leads asphyxia, vagal inhibition or laryngeal spasm leading to death.

Mechanical obstruction of oral cavity is termed as gagging. It is usually resorted to prevent the victim from shouting for help and death is usually not intended. At times, it may be homicidal, particularly when victims are infants or in individuals incapacitated by alcohol or drugs, old, infirms. Initially the gag only blocks the mouth and permits air entry through nostrils. Later the gag becomes progressively soaked with saliva and or mucus, becomes impervious and gets sucked in with inspiratory gasps. Finally, it obstructs the nasopharynx leading to complete obstruction of airways and may cause unforeseen death. The sequence of physiological events is bradycardia, decrease in respiration, eventual cessation of respiration, slowing and finally flattening of EEG.[18]

In case of gagging, gag should be examined for saliva, mucous and blood. Struggle marks can also be seen in various cases. Sometimes Sudden death due to vagal inhibition also occurs.

Causes of chocking

Chocking may be caused due to slipping of food stuff in respiratory tract, swallowing of pieces of metal, button, or chewing fiber by children etc. It is more common in young children due to lack of proper knowledge regarding selection bite and eating.

Café Coronary

The so called term Café Coronary denotes death resulted due to entry of food into air passages. If food enters into larynx during swallowing, it may occlude/close up the larynx completely. It is therefore also called 'foreign body upper airway obstruction.' When food obstruction of air passage could not be cleared through coughing, that may prevent breathing along with making person unable to speak and coughing. This may lead the person to death silently and quickly. In this situation, only autopsy of deceased will reveal the exact cause of death, after finding huge foodstuff in larynx.[19]

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[18] Pragati, Medicolegal Aspect of Suffocation (https://www.slideshare.net/pragati241997/suffocation-166841717)

Café coronary or foreign body upper airway obstruction claims more than 3,000 deaths each year in the United States. Early recognition of airway obstruction is imperative, because hypoxia of only four to six minutes' duration may result in irreversible brain damage. Fortunately, the foreign body preventing adequate air exchange can often be dislodged and expelled once the correct emergency procedures are implemented. The Heimlich maneuver or external subdiaphragmatic abdominal thrust is recognized as the basic procedure for relief of complete laryngotracheal obstruction. This technique, by elevating the diaphragm, can force a sufficient quantity of air from the lungs to create an artificial cough that is often of adequate force and duration to expel the obstructing foreign body from the airway. If non-invasive procedures prove to be ineffective, a cricothyrotomy should be performed by trained rescuers. Many of the victims of foreign body airway obstruction are either children or elderly. Most foreign body airway obstruction deaths can be avoided if the rescuer has been trained in the proper treatment.[20]

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[19] Supra note 1 at 158.

[20] Kitay Garry; Shafer, Nathaniel M.D. The Nurse Practitioner: June 1989 - p 35-46. Williams & Wilkins 1989 (https://journals.lww.com/tnpj/Abstract/1989/06000/Cafe_Coronary__Recognition,_Treatment_and.6.aspx Retrived: 2020-09-20)

Medico Legal Importance of Chocking

Besides common appearance of asphyxia, food stuff or other material that obstructed the larynx could be found in autopsy such as bolus of unchewed food. Chocking is usually accidental. It may be natural or occasionally homicidal. Examples of accident: blockage of the pharynx or larynx by a toy or food bolus. Natural: bacterial epiglottitis. Homicide: gag rammed into the mouth. Homicidal chocking is rarely possible in healthy adult victim however, children may be victim in rare circumstances.

Other than blockage of the airway, autopsy findings may be minimal. Although many forensic cases show agonal aspiration of gastric contents into the airway, to ascribe death in an adult due to food aspiration almost always requires neurologic disease (retardation, strokes, multiple sclerosis, etc.) or intoxication that impairs the normal gag reflex.[21]

[Arteries (Left) & Veins (Right) system in Cervical Region: See *figure 14.1 in figure section]*

D) Traumatic Asphyxia

Traumatic asphyxia denotes fixation of chest preventing free breathing flow of the lungs. Forceful pressure by any object against chest of victim prevents free chest movement creating severe obstruction on lungs resulting into difficulty to inhale adequate oxygen for surviving. Disaster such as house or building collapse, disaster in mines and factories, burial alive, run over by motor vehicle etc. creates constant pressure on chest.

In traumatic asphyxia extreme congestion over the chest can be found due to extreme pressure on chest. Besides this, gross hemorrhages (bleeding) from chest can be found. In case of traumatic asphyxia due to house collapse, dust particles resembling with house can be found over the chest and in lungs.

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[21] Andrew Baker, Investigating Asphyxial Deaths (https://www.umc.edu/som/Departments%20and%20Offices/SOM%20Departments/Pediatrics/Divisions/Forensic-Medicine/files/investigating_asphyxial_deaths.pdf Retrived: 2020-09-21)

E) Hanging

Meaning and Symptoms

Hanging is suspension of body by a ligature which encircles the neck, the constricting force being weight of the body. The whole weight of the body is not necessary, only a comparatively slight force (in partial hanging weight of the head) is enough to produce death. The suspension produces force to constrict the air passage and obstructs the respiration leading asphyxia. Ligature refers to any object used for suspending the body such as rope, wire, scarf, shawl, shoe lace etc. that is used to encircle the neck.

For death due to hanging, complete hanging or whole body weight is not necessary. Weight of the head (5kg-6kg) is enough to act as constricting force.[22] So death happens in partial hangings also, which are on toes, feet touching, sitting, kneeling and lying down postures.[23] Hanging produces painless death for the victims and there are no costs involved other than that of the ligature material. A thin rope around the neck will cause unconsciousness in 15 seconds.[24]

If about 2 kg or even lesser pressure is suddenly exerted on neck, it can immediately cause heart to stop (Reflex Cardiac Stoppage) and unconsciousness. If within 3 minutes, such person is not given cardiac massage or if the person is not given other treatment or if the person is not taken out from such unconscious position, death is inevitable. Therefore, death due to hanging is possible even if dead body is found to be partially hanged with half body lying on bed or legs touching on bed or ground.[25]

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[22] Ali E et.al.; Suicide by hanging: A study of 334 cases; Bangladesh Med J. 2014 May; 43 (2) {https://www.banglajol.info/index.php/BMJ/article/ download/21390/14695}

[23] Dr Eleza Ali, Lecturer, Department of Forensic Medicine, Sir Salimullah Medical College & Mitford Hospital, Dhaka. Also see: Dr Md Maksud, Assistant professor, Department of Forensic Medicine, Sir Salimullah Medical College & Mitford Hospital, Dhaka

[24] Dr S J Zubyra, Lecturer, Department of Forensic Medicine, Sir Salimullah Medical College & Mitford Hospital, Dhaka.

In hanging, death is usually due to asphyxia or cerebral anoxia or vagal inhibition leading to cardiac arrest or injury to the spinal cord.[26]

Sensations or instances that occur during hanging are:

1. **Loss of power and subjective sensations:** It is the first sensation. Flash of light, ringing and hissing noises in the ears are the subjective sensations felt by victim.
2. **Loss of consciousness:** It occurs within 15 seconds if thin rope is used. The consciousness is lost due to blockade of jugular vein creating cerebral congestion,[27]and blockade of carotid arteries creating cerebral ischemia[28] and anoxia.
3. **Stage of convulsion:** Convulsion refers sudden violent uncontrolled body movement due to constriction of muscles. In this stage the face is swollen (distorted) and livid, become prominent and there is violent struggling.
4. **Death:** It is the final stage of symptoms where the suspended person completely loses life.

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[25] Kanoon, 2058 B.S. V 28 (Dr. Harihar Wasti, Autopsy: Importance and Procedure: Eight myths in medico-legal sector), P. 22

[26] Nithin et al; Delayed Death in Hanging, J Forensic Res 2011, S1 DOI: 10.4172/2157-7145.S1-001 (https://www.hilarispublisher.com/open-access/delayed-death-in-hanging-2157-7145.S1-001.pdf)

[27] Presence of abnormal amount of blood due to blockade of venous flow

[28] Local anemia i.e. lack of blood due to mechanical obstruction

When a suicide is completed and the body is left in its position without any interference for some hours, following additional signs can be recorded:

a. Stretched and elongated neck: The neck is stretched and elongated and the head is always inclined to the side opposite to the knot of a loop or a noose.

b. Dribbling of saliva from the angle of mouth: Saliva is usually found dribbling from the angle of mouth while the head is drooping forward. In an Indian case, the bench cited "according to medical jurisprudence (Medical Jurisprudence & Toxicology, Moitra & Kausahal) in case of death due to hanging, there would be dribbling of saliva from the angle of mouth but there was no evidence to get effect in the case and it was clear that it was not a case of hanging."[29]

Also according to Modi, dribbling out of saliva is a sure sign of hanging taken place during life as the recreation of saliva being a vital function cannot occur after death.[30]

Thus, dribbling saliva is an important evidence to determine whether the particular suspended person was alive at the time of hanging or is hanged after death with motive to conceal the homicide.

c. Presence of ligature mark: Ligature mark of object used in hanging will be present around the neck of the suicide. The thickness, appearance or clarity of the ligature mark depends upon the types of ligature applied and the time lapsed after hanging. In case of suicidal hanging ligature mark is oblique, non continuous, placed high up around the neck, is grooved, parchmentised and abraded at places. The upper margin of ligature mark has a line of post mortem staining all around above the ligature mark. The shape of ligature mark is usually 'V' in case of typical hanging with contact of knot with skin.[31]

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[29] Mohan & Anr. v. State, 1996 Cr L J 48

[30] P. Jaising Modi, Modi's Medical Jurisprudence and Toxicology 191 (B V Subramanyam eds, 22nd ed. 1999).

d. Post mortem lividity: If dead body was uninterrupted, post mortem lividity is seen in legs and lower parts of hands due to gravity.

Types of Hanging

On the basis of manner and suspension, hanging could be classified as:

a) Partial hanging: Supreme Court of Nepal, in *Madhav Panta* case[32] cited Modi's Medical Jurisprudence 22nd edition page 251 to define partial hanging as hanging from a low point of suspension. In partial hanging, comparatively little force of about 4.5 kg. is enough to occlude (block/obstruct) blood vessels of neck, the term partial hanging is used for such cases in which the bodies are partially suspended, or for those in which the bodies are in sitting, kneeling, reclining, prone or any other posture, in all such cases, death is inevitable from asphyxia, if there is enough force upon the ligature to constrict the neck.

b) Accidental hanging: For a person to be hanged accidentally, ligature need not require to completely encircle neck. It is sufficient if it is applied beneath the chin as to compress the sides of the neck. This may be seen in children during play, while climbing trees, workmen in falling from scaffolding, athletes with habit of exhibiting hanging etc.

c) Suicidal hanging: This is common method of committing suicide. Usually, victim stands on a stool, chair or other platform and jumps off or kicks always the support. In rare case, the suicider ties own hands together to prevent a change of mind.

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[31] Supra note 3at 519-520.
[32] Madhav Panta v. HMG (decision date 2060/4/23, unpublished)

d) Homicidal hanging: It is extremely rare. It is difficult for a single assailant to hang another person against the person's will unless the victim becomes unconscious by injury or intoxicated with drug or is a child or a very weak person. Signs of homicidal hanging are:

i. Presence of violence marks in body parts of victim.
ii. Presence or mark of dragging in some cases.
iii. Disorder of furniture or other objects at crime scene.
iv. Pattern of ligature dragging from downward to upward could be seen in acute/quick examination of ligature.
v. Clothing of deceased is torn or disordered.
vi. Presence of injuries, either offensive or defensive.
vii. Scratches and nail marks etc.

These symptoms indicate manual strangulation making the probability of murder strong. In all doubtful cases, circumstantial evidences are important.

e) Lynching: Hanging of a suspect or enemy etc. by a mob (crowd of people). Usually, this was practiced in African region in past to punish black person committing heinous crime against white people such as rape of white women.

f) Post mortem hanging: A person may be murdered and then dead body suspended to simulate suicide. Offender often does this to conceal crime and avoid criminal sanction. A ligature applied to neck within two hours of death will produce ligature mark.[33] Supreme Court in *Sher Bahadur*

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[33] Dr. K.S. Narayan Reddy, The Essentials of Forensic Science and Toxicology 294 (21st ed. 2002).

Gurung case[34] has also recognized- ligature mark is seen even if someone murdered is hanged immediately after such killing. Accordingly, the neck will be elongated if the suspension was continued for long time. This may create likelihood confusion between suicidal hanging and homicidal hanging. In order to avoid confusion following things should be carefully examined:

1. Signs of dragging, if any, at the place of suspension.
2. Beam/branch of tree shows evidence of the rope having dragged/moved from below to upwards as the body is pulled up. In true suicidal hanging, examination of rope fibers revel that the rope has been moved from above to downwards direction.
3. Fibers from the rope may be found on the hands of the victim in suicidal hanging, but not in case of post-mortem hanging.
4. In case of post mortem hanging dribbling of saliva could not be seen due to prior inactivity of secretion by salivary glands.
5. Other injuries may be found at the dead body or post mortem may reveal administration of poison etc.
6. If the place of hanging is very wet, presence of foreign foot mark may be noticed.

g) **Judicial hanging:** Hanging of a criminal convicted for capital offence as part of executing punishment served through competent judicial body is known as judicial hanging. Judicial Hanging is lawfully practiced in India and China. This is not allowed by the Constitution of Nepal, 2015 as Article 16 prohibits enacting laws for death penalty and Article 1 declares Constitution as fundamental law of Nepal. Any laws if made against this constitutional sprit is void and gets ultra vires by a decision from Supreme Court in accordance to the power conferred by Article 133 of the Constitution.

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[34] Sher Bahadur Gurung v. GoN; Homicide, NKP 2075 V 2 FB, DN 9944

h) Typical and Atypical hanging: On the basis of knot position, hanging could be of two types. Typical hanging and Atypical hanging. In typical hanging, body is suspended by ligature with a point of suspension at centre of occiput, i.e. when the knot is at the nape (back) of neck. In atypical hanging, the point of suspension is not at occiput i.e. the knot is not at nape of neck. Here the knot in hanging is at other position than nape of neck.

Causes of Death in Hanging

1) Asphyxia: The constricting force of the ligature causes compression; narrowing the laryngeal and tracheal lumen and blocks the airway.

2) Cerebral congestion: The jugular veins are blocked by the compression, which results in stoppage of cerebral circulation and a rapid rise in venous pressure in the head causing unconsciousness.

[Veins and arteries in neck : *See figure 14.2 in figure section]*

3) Combined asphyxia and cerebral congestion: This is the commonest cause.

4) Cerebral anemia or ischemia: Pressure on the large arteries, i.e. carotid arteries and vertebral arteries (only these two arteries supply blood and oxygen to brain) on the neck produces cerebral anemia (lack of blood and oxygen) and immediate coma (deep unconsciousness lasting for a long time).

5) Fracture or dislocation of the cerebral vertebrae:

Heart	Brain	Consequences
Stopped	Alive	Artificial pump can work and revive the person
Stopped	Stopped	Artificial respiration cannot work

Post Mortem Appearance in Hanging

Autopsy of hanged deceased could have following peculiar post mortem appearance:[35]

a) A dry, white and glistering subcutaneous tissue is seen underneath the ligature mark after careful dissection of the epidermis of the neck.

b) The carotid arteries may be found in ruptured condition.

c) If great force was applied in hanging, neck muscles may be found ruptured.

d) Larynx may be fractured.

e) Hyoid could be seen congested.

f) Post mortem lividity could be found in leg side.

g) Petechial hemorrhages may be seen in lungs, heart, and abdominal organs.

h) Abdominal organ, lungs and brain may show congestion.

The right side of heart may be filled with dark fluid and due to hemorrhage left side may empty.[36]

Microscopic examination of post mortem appearance and general appearance and the circumstantial evidences is vital in

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[35] R.K. Sharma, Concise Textbook of Forensic Medicine and Toxicology, 55 (3rd ed. 2011).

[36] Babulal v. State of Chhattisgarh, High Court of Chhattisgarh, Bilaspur CRA No. 154 of 2005 (Retrieved on 08-10-2020; http://highcourt.cg.gov.in/Afr/courtJudgementandAFR/2016/November/CRA154of2005.pdf)

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investigation of case of hanging in order to differentiate between the suicidal hanging and homicidal hanging. Unless otherwise provided the case of hanging is considered as suicidal. Thus, it is the duty of investigation officer to collect adequate evidence to refute the presumption of suicide to establish guilt to any accused in homicidal hanging. The postmortem examiner could be examined to ascertain whether suicider had died due to hanging or was hanged after death.

Difference between Ante Mortem Hanging and Post Mortem Hanging

Following differences could be noticed in ante mortem hanging and post mortem hanging:

S.N.	Basis	Ante mortem hanging	Post mortem hanging
1	Motive behind hanging	Usually suicidal. This may be homicidal in case of lynching or if the victim is minor or is physically or mentally disable.	Drama of suicide to conceal other forms of homicide
2	Ligature mark	A well developed and prominent ligature mark is seen.	If body is hanged within 2 hours after death, ligature mark may be developed but may not be prominent. Similarly, post mortem staining on upper side of the ligature mark may not be seen.
3	Saliva	Dribbling of saliva from the angle of mouth is usually seen because of pressure on salivary glands of the alive suicide.	There is absence of dribbling of saliva.

4	Injuries in other body parts	No other ante mortem injuries could be found in body parts.	Usually found. Sign of struggle and violence.
5	Asphyxial features	Asphyxial features such as congestion, cerebral congestion, cerebral anemia, petechial hemorrhage etc. could be seen.	No asphyxial signs are seen due to prior death caused by other reason.
6	Condition of scene of crime	Closed room or aloneness. No marks of violence are present.	Marks of violence could be seen at the scene of crime.
7	Dragging sign of the body	Not present	May be seen
8	Pattern of ligature's fiber	Upward to downward inclination of the fiber in ligature. Minimum friction.	Down to upward fiber inclination pattern in ligature due to application of force used in lifting the deceased. Higher friction between rope and suspension frame.
9	Presence of fiber of ligature in hands of suspended deceased	The suicide oneself prepares knot and fits ligatures, thus fibers may be attached to his hand.	Not present.
10	Suicide note	May be present	Never present, however offender may leave fake suicidal note to conceal crime. Handwriting examination reveals truth.

F) Strangulation

Strangulation is defined as the compression of the neck by a force other than hanging. In strangulation, the pressure is exerted on neck by some means. Such pressure not only obstructs the breathing system but also causes severe damage to other sensitive parts such as jugular vein, hyoid, carotid artery, air canal, and sometimes vertebrae too. On the basis of material used for strangulation, it can broadly be categorized into two types (a) Manual Strangulation (Throttling), and (b) Strangulation by Ligature. Weight of the body has nothing to do with strangulation. Strangulation is a violent form of death, which results from constriction of neck by a ligature or by any other means, without suspending the body.

The general clinical sequence of a victim who is being strangled is one of severe pain, followed by unconsciousness, followed by brain death. The victim will lose consciousness by any one or all of the following: blocking of the carotid arteries (depriving the brain of oxygen), blocking of the jugular veins (preventing deoxygenated blood from exiting the brain), and closing off the airway, causing the victim to be unable to breath. It is estimated only 11 pounds of pressure applied to both carotid arteries for ten seconds leads to unconsciousness.[37]

How-ever, if pressure is released immediately, consciousness will be regained within ten seconds. To completely close off the trachea, three times as much pressure (33 lbs.) is required. Brain death will occur in 4 to 5 minutes, if strangulation persists.[38]

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[37] Diana Faugno et.al: Strangulation Forensic Examination: Best Practice for Health Care Providers; October 2013 Advanced emergency nursing journal 35(4):314-27.

[38] McCance & Heuther. (2010). Pathophysiology. (Sixth Edition). Maryland Heights, MO: Mosby Elsevier; Also see: Strack, G., & McClane, G. (1999). How To Improve Your Investigation and Prosecution of Strangulation Cases. Retrieved

Types of Strangulation

On the basis of means applied to produce constriction in neck, strangulation could be of two categories. They are:

a) Manual Strangulation / Throttling:

If fingers and palms upon the throat (bare hands) are applied to produce constriction at neck, it is called throttling or manual strangulation. When strangulation is brought about by compressing the throat with a foot, knee, bend of elbow, or some other solid substances, it is known as mugging (strangle hold).[39] The mugging may lead to hypoxia or anoxia of the victim. The act of throttling produces pressure in jugular vein, hyoid, carotid arteries, respiratory canal or even larynx.

b) Strangulation by Ligature

If ligature such as flexible rubber tube, rope, belt, scarf, clothes, wire, metal wire, stick, wooden planks, plastic rope, and so on is applied to encircle neck to produce constriction, it is called strangulation by ligature. Here, the ligature is only used to cause asphyxia in which weight of the body of victim is not the constricting force, unlike in hanging. In strangulation, the constricting force is applied by offender oneself without suspending victim.

In *Chakra Bahadur Dangi* case,[40] defendant applied both manual strangulation and strangulation by ligature to cause death of the victim. Firstly, the defendant pressed the neck of deceased by his hand. Thereafter, he cut a wire with sickle and wrapped wire at neck of deceased. Accordingly, in another

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from the National Center on Domestic and Sexual Violence website at http://www.ncdsv.org/images/strangulation_article.pdf

[39] Javed Abdul Rajjaq Shaikh v. State of Maharashtra, (2019) 10 SCC 778 Criminal Appeal No. 1181 of 2011.

[40] Chakra Bahadur Dangi v. Government of Nepal 2071, D.N. 9188

case[41] the defendant used strangulation by ligature to take life of the victim. The defendant repeatedly hit the head of the victim along with throttling which resulted victim unconscious. Thereafter, the defendant constricted neck of victim by her scarf as ligature.

Variations of ligature strangulation include Bansdola, Mugging and Garroting. In bansdola, a wooden pole or rod is placed over the front of, and behind the neck. One end of these rods is fastened together by a rope. Other ends when forcefully brought together squeeze the neck to cause death. In mugging, squeezing of victim's neck is done in the crook of the elbow, or the bend of the knee. Garroting is a method of judicial execution in some countries. Victim is made to wear a neck collar of metal. Death is caused by tightening the collar. Since there is upward pull, the resulting ligature mark may resemble that of hanging.

Symptoms of Strangulation

If the windpipe is suddenly and completely closed, individual is rendered powerless to call for assistance, becomes insensible, and may die instantly. Whereas if the windpipe is not completely closed, the face of the victim becomes cyanosed, bleeding occurs from mouth, nostrils and ears. Cyanosis, a bluish or purplish discoloration of skin or mucous membranes is caused due to low oxygen saturation in the tissues near the skin surface. Hands are clenched and convulsions precede delayed death. A pale face would indicate a rapid death from reflex cardiac arrest, while face with petechiae would suggest a delayed death.[42] In case of manual strangulation, the round mark of the finger may be seen at the neck of deceased.

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[41] Amber Bahadur Pun Magar v. Nepal Government 2070, D.N. 8988

[42] Amar Iqbal Singh vs State Of Punjab on 3 March, 2009, HC of Punjab and Haryana, Criminal Appeal No. 684-SB of 1996,Date of decision: 3rd March, 2009 (https://indiankanoon.org/doc/1100323/)

In the case of application of ligature to constrict the neck the horizontal mark of ligature, impression of ligature mark, congested face etc could be recorded as symptoms of strangulation by ligature.

Redness (erythema) on the neck may be fleeting, but may demonstrate a detectable pattern.[43] These marks may or may not darken to become a bruise. Bruises (ecchymoses or purpura) may not appear for hours or even days. Fingertip bruises are circular and oval, and often faint. A single bruise on the neck is most frequently caused by the assailant's thumb.[44]

However, bruises frequently may run together, clustering at the sides of the neck, as well as along the jaw lines, and may extend onto the chin, and even the collar bones (clavicles).

Chin abrasions are also common in victims of manual strangulation, as the victim lowers the chin in an instinctive effort to protect the neck, and in doing so scrapes the chin against the assailant's hands.

The tiny red spots (petechiae) characteristic of many cases of strangulation are due to ruptured capillaries - the smallest blood vessels in the body - and sometimes may be found only under the eyelids (conjunctivae).[45] However, sometimes they may be found around the eyes in the periorbital region, anywhere on the face, and on the neck in and above the area of constriction. Petechiae tend to be most pronounced in ligature strangulation.[46] Blood red eyes (subconjunctival hemorrhages) are due to capillary rupture in the white portion (sclera) of the eyes. This phenomenon suggests a particularly vigorous struggle between the victim and assailant.[47]

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[43] Noriaki Ikeda, M.D., Akira Harada, B.S., and Tsuneo Suzuki, M.D.; Homicidal Manual Strangulation and Multiple Stun-Gun Injuries. American Journal of Forensic Medicine and Pathology, 13:4, 1992, 32-23.

[44] Teet Harm and Jovan Rajs; Face and neck injuries due to resuscitation versus throttling. Forensic Science International, vol. 23, 1983, 109-15.

[45] F.A. Jaffe; Petechial Hemorrhages: A Review of Pathogenesis. The American Journal of Forensic Medicine and Pathology. 15:3, Sept. 1994, 203-07.

Cause of death

In strangulation death is generally due to asphyxia either hypoxia or anoxia. However, other causes may also result by the act of strangulation that takes the life of a person. Some of them are as follows

a) Cerebral ischemia or venous congestion (due to compression of the carotid arteries or jugular veins).

b) Asphyxia and venous congestion combined. (Asphyxia is due to compression of the laryngopharynx, larynx, or trachea).

c) Shock due to reflex cardiac combined:

   a. A pale face indicates rapid death from reflex cardiac arrest. ('vagal inhibition' or 'reflex cardiac arrest', involving stimulation of the carotid sinuses.[48])

   b. It occurs at least in half of deaths from manual strangulation.

d) Very rarely the fracture of cervical vertebrae.

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[46] James. L. Luke, M.D.; Strangulation as a Method of Homicide. Arch Pat. Vol. 83, Jan. 1967, 64-70.

[47] http://www.ncdsv.org/images/strangulation_article.pdf

[48] When sudden and intense stimulation occurs around the baroreceptors in the neck, afferents in the IXth cranial nerve are excited. These connect to the vagus nerve (Xth cranial nerve) in the brainstem, which brings about slowing of the heart, fall in blood pressure and sudden death. This is 'reflex vagal inhibition'. (Parveen Bawa, Professor Emerita at Simon Fraser University since 1978 Retrieved: https://www.quora.com/What-is-the-mechanism-of-reflex-vagal-inhibition)

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Treatment

Treatment is hardly necessary but in cases of necessity- (i) constriction of neck should be removed. (ii) Artificial respiration should be started at once. This may be assisted by the application of ammonia to the nostrils or inhalation of oxygen.

After recovery, the patient may die of any of the secondary complication, such as convulsions, paralysis, lesions of the larynx and lungs or from abscesses.

External Appearance in Strangulation

External signs and marks caused by strangulation can be classified in two groups:

1) Appearance on the neck

The external appearances that may be seen over the neck differ from the means applied to produce constriction. If ligature is used, the mark of ligature is well defined and slightly depressed corresponding roughly to the breadth of the ligature. It is found encircling the neck horizontally and completely. In strangulation, unlike hanging, the ligature mark is transverse. However, the mark may be oblique as in hanging, if the victim was dragged by the ligature or strangled in recumbent posture or if the victim was sitting and the assailant applied ligature on the neck while standing behind him thus pulling upwards and backwards.[49]

A study[50] showed that ligature mark was incompletely encircling the neck in 35 cases (85.36%) of hanging. On the other hand, the ligature mark was complete around the neck in all cases (100%) of ligature strangulation. These findings are in agreement with other studies by Momin et.al, [51] Sharma et.al, [52] and Naik. [53] It is a well known fact documented in literature that discontinuity along the course of the ligature mark is an important differentiating feature between hanging and strangulation.[54]

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[49] Simpson. Asphyxia. In: Simpson's forensic medicine.12th edn. London: Arnold, Odder Headline Group, 2003: 92-96.

[50] Arif M. Ligature mark on the neck; How elucidative?. Professional Med J 2015;22(6):798-803.(https://applications.emro.who.int/imemrf/Professional_Med_J_Q/Professional_Me Med_J_Q_2015_22_6_798_803.pdf)

More than one knot in suicides is not unusual.[55] The use of more than one ligature has been reported in suicides, as well as up to 20 turns.[56]

In case of throttling, pressure marks by thumb and fingertips are usually found on either side of the windpipe. The thumb marks are ordinarily higher and wider on one side of the front of the neck and the finger marks are situated to its other side obliquely downwards and outwards and one below the other. If stick or foot is used over the neck, there is a bruise in the middle of the front neck corresponding to the width of the instrument used. If two sticks are used, severe local injury may be evident.

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[51] Momin SG, Mangal HM, Kyada HC,Vijapura MT,Bhuva SD. Pattern of Ligature Mark in Cases of Compressed Neck in Rajkot Region: A Prospective Study. J Indian Acad Forensic Med. 2012; 34(1):40- 43.

[52] Sharma B R, Harish D, Singh V P, Singh P. Ligature Mark on neck: How informative? J Ind Acad Forensic Med 2005; 27(1): 10 -15.

[53] Naik S K. Obliquity vs. discontinuity of ligature mark in diagnosis of hanging – A comparative study. Anil Agarwal internet journal of forensic medicine and toxicology 2006. 7(1). Available online http://www.anilaggrawal.com/ij/vol_007_no_001/papers/paper005.html.

[54] Vij K. Asphyxial Deaths. In: Textbook of Forensic Medicine and Toxicology, principles and practice. 4th Ed. Elsevier, A division of Reed Elsevier India Private Limited; 2009. p. 117-190.

[55] Kamil Hakan Dogan, Zerrin Erkol; Suicide by Ligature Strangulation Three Case Reports, Lippincott Williams & Wilkins (2009). (Article in The American journal of forensic medicine and pathology: official publication of the National Association of Medical Examiners. November 2009.) (Retrieved from (08-10-2020): https://www.researchgate.net/publication/38078596)

[56] Maxeiner H, Bockholdt B. Homicidal and suicidal ligature strangulation-a comparison of the post-mortem findings. Forensic Sci Int. 2003;137:60-66 (https://www.researchgate.net/publication/38078596).

2) General asphyxial appearance in strangulation:

Following signs of asphyxia could be recorded on deceased:

- Face is puffy and cyanosed and marked with petechiae
- Conjunctivae are congested and pupils dilated
- Petechiae seen in the eye lids and the conjunctivae
- Lips blue and dark, swollen, protruded, tongue occasionally beaten by teeth
- Hands usually clenched
- Genital organs may be congested and there may be discharge of urine, feces and seminal fluid.

Internal Appearances in Strangulation

Post mortem examination reveals following signs in deceased:

- The cornua of hyoid bone may be fractured in strangulation by ligature
- Brain and meninges are congested with frequent presence of minute hemorrhagic spots
- Lungs are congested
- Congestion and petechiae may be found under the mucus membrane of the lumen of larynx and trachea
- Superior cornua of thyroid cartilage may be fractured
- Right side of heart is full of dark fluid blood and left empty
- But sometimes both cavities are found full, if the heart stopped during diastole

[Larynx (showing cartilages & ligaments) : *See figure 14.3 in figure section]*

Medico Legal Aspects in Death Due to Strangulation

a) Most of the strangulation death occurs due to cerebral hypoxia due to blockage of arterial inflow, or stagnation of blood in the head due to blockage of venous outflow. Approximately ¾ of the blood supply to the brain is via the carotid arteries. It is estimated that approximately 11 pounds of pressure is needed to occlude (close) the carotid arteries; while only 4.4 pounds of pressure is needed to occlude the jugular veins. Occlusion of the trachea is said to require 33 pounds of pressure, while the vertebral arteries require 66 pounds of pressure.[57]

b) Whether death was caused by strangulation? Effects of violence in the underlying tissues in addition to the ligature marks or bruise marks caused by the fingers or by the foot, knees etc. are useful to determine the cause of death.

c) Whether the strangulation was suicidal, homicidal or accidental? Suicidal strangulation is not common. In case of homicidal strangulation one or more knobs, ligature marks, foreign finger marks and struggle marks may be found clearly. Accidental strangulation may occur when an article of clothing such as a neck bond, a cord or a chain is tightly drawn round the neck all of a sudden.

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[57] Andrew Baker, Investigating Asphyxial Deaths (https://www. umc.edu/som/Departments%20and%20Offices/SOM%20Departments/Pediatrics/Divisions/Forensic-Medicine/files/investigating_asphyxial_deaths.pdf Retrived: 2020-09-21)

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Differences between hanging and strangulation

Differences	Hanging	Strangulation
Mode of death	Usually suicide.	Mostly homicidal
Face	Usually pale and petechiae rare	Congested livid and marked petechiae
Saliva	Dribbling out of mouth. Down on chin and chest	Not dribbling
Neck	Stretched and elongated	Not so
External signs of asphyxia	Usually not well defined	Very well marked (except in death due to vasovagal attack and carotid sinus effect)
Bleeding from the nose, mouth and ears	Very rare	May be found
Ligature mark	Oblique (inclined) plus non continuous. Placed high up in the neck between the chin and the larynx. Base of the furrow being hard, yellow and parchment like.	Horizontal or transverse and continuous round the neck. Base of the furrow being soft and reddish.
Subcutaneous tissue under the mark	White, hard and glistening	Ecchymosed
Injury to the neck muscles	Rare	Common
Rupture of	Inner coats of the carotid arteries are ruptured/ torn in violent cases of hanging such as long drop	Carotid arteries' internal coat ordinarily ruptured
Fracture of larynx, trachea	Very rare (even in judicial hanging)	Fracture of larynx, trachea and even hyoid bone is often found

Fracture or dislocation of cervical vertebrae	Common	Rare
Scratches, abrasions and bruises on the face, neck, and other body parts	Usually not found	Usually present
Emphysematous bullae on lungs surface	Not present	May be present

[Cervical Spine (showing bones, nerves, discs, & blood vessels): *See figure 14.4 in figure section]*

In *Laxmi Prakash Saksena* case,[58] autopsy expert testified- 'in case of homicidal hanging, there has to be presence of struggle mark bodily injuries in the medico-legal examination of defendants'. Evidences of such marks were absent in the case file. Yet high court convicted assuming that deceased might be sleeping during the time of offence. Supreme court laid- "The role of court is not to assume and presume how death might have happened but to decide relying on the scope of what the existing evidences show. In homicide, victim fully tries to defend oneself and during such time, there are chances of abrasions and defense wounds inflicted into the body of perpetrator by victim during struggle. Such wound is detected during medico-legal examination of defendant." Likewise, the court also held- "self-written suicide note is a form of dying declaration."

Usually no bleeding from nostrils and ears is found in hanging, but such bleeding exists and blood accumulation is seen inside neck in strangulation. Supreme court confirmed death from strangulation and not hanging in *Ramesh Mandal Gangain* case[59] on the basis of dead body examination inventory showing bleeding from nostrils and ear corroborated with autopsy report showing blood accumulation inside neck.

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[58] Laxmipraksh Sexsena v. GoN, 2073 D.N. 9586

[59] Ramesh Mandal Gangain et.al. v. GoN; Homicide, NKP 2076, V 7, FB, DN 10302.

Difference between Throttling and Strangulation by Ligature

Differences	Throttling	Strangulation by ligature
Means used to produce constriction	Hand (Finger and palm)	Ligature is encircled over the neck as tool to constrict the neck. Objects other than hand.
Marks over the neck	Marks of finger, thumb, scratches of nail are seen	Horizontal mark of ligature and the impression of ligature pattern over the neck could be seen.
Fracture of hyoid bone	Usually found	Less common

G) Drowning

Meaning and Types

Drowning is a form of asphyxia due to aspiration of fluid into air passages caused by submersion in water or other fluid. Complete submersion in not necessary to result death, even submersion of nose and mouth alone for a sufficient period can cause death from drowning.[60] Due to entry of large volume of fluid in the lungs and air passage, the breathing system will be obstructed.

Universal definition adopted in 2002 by WHO provides "Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid." Submersion denotes airway is *below* the surface of the liquid. Immersion denotes the airway is *above* the surface of the liquid (eg. taking a bath). There was also consensus among WHO experts that the terms- wet, dry, active, silent, near, and secondary drowning would no longer be used. Global Report of WHO[61] highlights that 372,000 people get drowned worldwide each year. Drowning is among the ten leading causes of death for children and young people in every region of the world.[62]

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[60] Supra note 18 at 60

Supreme Court in *Midhan Bahadur Raske Magar* case[63] convicted 3 defendants for accidental homicide (*bhabitabya jyaan*) where deceased girl falls down suddenly into river while escaping from defendants to defend herself from being raped. As per autopsy report, cause of death was drowning and absence of any other bodily injuries on her body.

Mechanism Involving in Drowning

In drowning, a person dies by passing through following step-by-step process:

a) Sinking of body to the bottom: When a non-swimmer falls into water, the person sinks partly due to the force of fall and partly due to specific gravity of the body which is 1.08.

b) Rise to the surface: Shortly afterwards, he rises to the surface due to natural buoyancy, a tendency to float in water or other liquid.

c) Inhale of water: When the person cries for help and struggles, the person is likely to inhale water. This produces coughing and drives out large volume of air out of lungs, and some gastric contents. More water enter into lungs and stomach increasing the weight and the person sinks again.

d) Sinks again into water: Then cerebral hypoxia will continue until the person is rescued and eventually death occurs.

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[61] WHO Global Report- Drowning: Preventing a Leading Killer, published in 2014.
[62] https://www.who.int/violence_injury_prevention/other_injury/drowning/en/
[63] Nepal Government v. Midhan Bahadur Raske Magar et.al. 2070, D.N. 8944

The struggle for life with rising and sinking of the body goes on for a variable period depending on the vitality of such person (generally 2 to 6 times), until the person remains submerged. Consciousness is usually lost within three minutes of submersion. Convulsive movements then occur, followed by coma or suspended animation and death. Death usually occurs in four to eight minutes of complete submersion. According to R.N. Karmakar[64] - asphyxia usually occurs by 2 minutes, consciousness is lost by 3 minutes of submersion, and heart stops by next 2 to 5 minutes. The body may remain in the state of suspended animation or coma prior to death. Time taken for death to occur is variable and usually occurs by 2 to 12 minutes.

Cause of Death in Drowning

Based on nature of water, the cause of death in drowning is different in fresh water and in salt water. This is due to the direction of water flow though the semi permeable membrane of lungs under osmotic pressure.

1) In Fresh Water

Cause of death in fresh water is primarily due to heart failure before cerebral anoxia takes place. In fresh water drowning, water filled in lungs has higher water concentration than the circulating blood within the body. So through osmotic pressure, the water inside lungs is massively absorbed through the semi permeable membrane of lungs resulting in a maximum increase of blood volume by 50% in one minute. This results in excess dilution of blood plasma causing rupture of red blood cells releasing potassium, a heart muscle poison. Similarly, disturbed sodium potassium ratio produces irregular heartbeat (cardiac arrhythmia or heart arrhythmia causing too fast or too low heartbeat), ventricular tachycardia and fibrillation. Thus, in fresh water drowning all abnormalities is seen due to haemodilution.

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[64] R.N. Karmakar; Forensic Medicine and Toxicology, Edn. 3rd, Academic Publications, Kolkata (2010) p. 175.

2) In Sea Water

In seawater drowning, the primary cause of death is severe pulmonary oedema.[65] Heart failure is less rapid than in fresh water drowning and survival is longer. The water concentration is higher in blood than in the salty water filled inside lungs as a result the water within the blood of person flows from circulating blood towards the lungs ultimately reducing the blood volume, blood pressure and causing haemoconcentration of victim. However, haemodilution is far more dangerous than haemoconcentration.

Besides these above two general causes of death in drowning, other specific causes of death involved in drowning are:

1) Asphyxia: Inhalation of fluid causes obstruction to the air passages. Circulatory and respiratory failure occurs simultaneously, due to anoxia of both the myocardium and respiratory centre. As complete submersion, this is a form of wet drowning where body is completely submerged in the fluid. In wet drowning, there is a common feature i.e. the lungs are full of water, the person inhales water which interferes with respiration and causes the circulatory system to collapse. The cause of death in this type of submersion is different in fresh water and in salt water as already discussed above.

Surprisingly, though 90% of drowning victims aspirate water (according to autopsy studies), the aspirated volume varies greatly, from lots to virtually none. The vast majority of them aspirate less than 22ml per kg of body weight.[66] In short, they don't exactly fill their lungs with it. The aspiration of pure water is actually a rather mild experience, from the standpoint of hypoxia.

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[65] Swelling from excessive accumulation of watery fluid in cell, tissues

Submersion of only nose and mouth in fluid for adequate time is sufficient to lead drowning and there is no need of complete submersion of body. This may be more common in case of heavy intoxication or immediate unconsciousness after face falling into water sources or homicidal drowning to weak, minor or elderly victim.

2) Ventricular Fibrillation: In fresh water drowning, death may occur in three to five minutes from a combination of anoxia and a disturbed sodium potassium ratio producing arrhythmias of the heart beat, ventricular tachycardia and fibrillation.

3) Laryngeal Spasm (Dry drowning): Laryngeal spasm may result from inrush of water into the nasopharynx or larynx. In death due to laryngeal spasm, a very little water may enter the lungs but asphyxia signs are present. Laryngospasm is in fact the reflex which prevents foreign material from entering the trachea, and it is therefore appropriate to develop laryngospasm when drowning. Unfortunately, the onset of hypoxia causes the larynx to relax, and water still finds its way into the lung. Furthermore, the incidence of laryngospasm must be fairly low, no greater than 10%. This conclusion is arrived to on the basis of autopsy series, where only around 10% of patients have ended up dead from hypoxia *without* much fluid in their lungs. Of these patients, it must be assumed, a

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[66] Modell, Jerome H., and J. H. Davis. "Electrolyte changes in human drowning victims." *Anesthesiology* 30.4 (1969): 414. (Retrieved on 08-10-2020: https://derangedphysiology.com/main/required-reading/trauma-burns-and-drowning/Chapter%204.0.7/immersion-submersion-and-drowning)

few died because of obstructive asphyxia, as the consequence of laryngospasm. In years gone by, this was called "dry drowning".[67]

Presence of huge amount of fluid in the lungs and air passage is not necessary in all cases of drowning. Sometimes, when person is suddenly thrown into water or when a person dives into water, there may occur instant laryngeal spasm (constriction of larynx) preventing air as well as water from entering into lungs. It is called dry drowning because water never reaches the lungs. Instead, breathing in water causes vocal cord to spasm and close up. This shuts off airways making it hard to breath.

In this situation of laryngeal spasm, person dies with absence of usual characteristics and symptoms of drowning. Death of a victim found in water should not always be related to drowning. A vagal reflex may be also induced by inhalation of water, it will increase peripheral airway resistance with pulmonary vasoconstriction, decreased lung compliance and reduction of ventilation - perfusion ratios. An intense stimulation of nerve endings at the skin, the mucosa of the ear drum, the pharynx or the larynx by cold water can lead to a cardiac reflex arrest. It was assumed that 10% of the drowned humans die after laryngospasm or breath-holding without actually aspirating fluid. In drowning, the small amount of water inhaled, particularly cold water, may induce vaso vagal reflex or cardiac arrest reflex. When great amount of water is inhalated and pass through the alveolar-capillary interface and enter the circulation, the phenomenon of destruction of surfactant and of the alveoli architecture leads to asphyxia.[68] During the entering of water into the blood stream, the diatoms present in the drowning fluid may reach the internal organs.

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[67] https://derangedphysiology.com/main/required-reading/trauma-burns-and-drowning/Chapter%204.0.7/immersion-submersion-and-drowning

'Dry drowning' and 'Secondary drowning' aren't actually medical terms but they do point some rare complications that we should know about and they are more common in children. 'Secondary drowning' is another drowning complication that happens if water gets into the lungs. There, it can irritate the lungs' lining and fluid can build up, causing a condition called pulmonary edema. In case of child, parents may notice their child having trouble breathing right away, and it might get worse over the next 24 hours. Both events are very rare. They make up only 1%-1%-2% of all drowning, says pediatrician James Orlowski, MD, of Florida Hospital Tampa.[69]

4) Vagal Inhibition: If person fall into icy cold water, is under high emotion, excitement, and unexpected immersion, it could result into vagal inhibition causing death of the submerged person. The vagus nerve (cranial nerve X) is the longest nerve in the autonomic nervous system found in the human body. This nerve helps to regulate blood pressure, sweating, digestion, heart rate, and even speaking. It can also transmit messages to and from the brain to several organs in the body. This is because it's a nerve that innervates the heart, lungs and the digestive tract. There is one vagal nerve on either side of human body. Given the fact that this nerve is involved in controlling the heart, lungs and digestive tract (along with functions like swallowing,

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[68] Audrey Farrugia and Bertrand Ludes (September 12th 2011). Diagnostic of Drowning in Forensic Medicine, Forensic Medicine - From Old Problems to New Challenges, Duarte Nuno Vieira, IntechOpen, DOI: 10.5772/19234. Available from: https://www.intechopen.com/books/forensic-medicine-from-old-problems-to-new-challenges/diagnostic-of-drowning-in-forensic-medicine

[69] Amanda Gardner, What Is 'Dry Drowning'? (Retrieved from: https://www.webmd.com/children/features/secondary-drowning-dry-drowning#1)

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sweating and speaking), we can clearly tell how important it is to our body.

The vagus nerve exits our head, travels down the neck, into the thorax and, finally, all the way down into the abdomen. It's a really long and big nerve. As the nerve passes near the heart, it extends out little tentacles - like the fingers of our palm - which grab onto the heart. These tentacles, which are really just other nerves, help to put a stop to a high heart rate as well as to lower the heart rate. Vagus nerve also ensures food is well digested and body is well fueled with food. For this, it controls muscles that help swallow our food and move it along our digestive track in a process called 'peristalsis', series of muscular contractions and expansions in our gastrointestinal tract.

5) Exhaustion: Extreme fatigue or inability to respond to any stimuli may result death due to submersion.

6) Injuries: Fracture of skull and fracture or dislocation of cervical vertebrae may occur due to head striking against some solid object while diving in water. Concussion may occur due to striking the head against some hard substance or the water itself while falling from a height.

To establish the diagnosis of drowning, it is of particular importance to correlate information about the circumstances preceding the death, the past medical history of the victim if known, the circumstances of the body recovery from the water, the external examination, the autopsy findings and the results of the complementary analyses (histological, biochemical, toxicological analyses and diatom test).

Treatment of Drowned Person

First aid emergency treatment could be of two types: (a) Artificial respiration: It is given through- direct mouth to mouth breathing. Patient is made to lie down and head hyper extended.

Patient is allowed to exhale passively. This is repeated about 15 to 20 times per minute. This should be continued for about one hour or till natural respirations are restored. (b) Closed chest cardiac compression: It should be started immediately. The patient is made to lie on the back. The operator places his hands one on the top of other, on the lower end of the patient's sternum. Forcible rhythmic compressions are made 60 to 80 times per minute to empty the blood from the ventricles. The force of compression must be sufficient to produce pulsation in the carotid and femoral arteries.

Post Mortem Appearances in Death Due to Drowning

Examination of post mortem appearances is important to determine whether the deceased died of drowning or some other causes. Some major external and internal post mortem appearances in drowning are as follows:

1) External appearance:

a) The body, skin and clothes are wet when just rescued.

b) Skin becomes pale.

c) Eyes may be half opened or closed but pupils seem dilated.

d) A fine white lathery froth or foam is seen at the mouth and nostrils, which is one of the pathognomonic external signs of drowning. Froth is seen in death due to strangulation, acute pulmonary oedema, electric shock, during an epileptic fit, in opium poisoning and putrefaction as well. But in all these cases, it is not of such a large quantity as in drowning, and the bubbles are much larger. Even if the forth is not seen, when chest or stomach is pressed, white forth start coming out from mouth or nose.

Besides drowning, froth from nostrils and mouth could also be seen in case of death due to heart failure caused due to certain poisons, head injury, snake bite, and heart attack.[70]

e) Grasping of weeds, mud, stone etc. due to cadaveric spasm: Weeds, gravel, grass, sticks, twigs, leaves etc. present in the water may be firmly grasped in the hands due to cadaveric spasm. This strongly suggests that the person was alive when he drowned, because it indicates struggle of person for own life. Sand, mud, or other materials under the nails due to struggle have the same significance.

f) The skin becomes sodden, thickened, wrinkled and white, known as "washerwomen's hands" and "washerwomen's foot."

g) The submerged body floats in about 12 to 36 hours depending upon season and the built of person. Very obese or fat person and infants float earlier than a thin, heavily framed person. The body usually floats with the spine uppermost position i.e. face down position. The process of decomposition starts from the stomach. After advanced decomposition, the body usually turns to float in a belly up i.e. face up position.

2) Internal appearances:

a) Asphyxia signs may be seen.

b) Fine white froth in mouth and nostrils are present.

c) Fine froth in the lungs and air passage.

d) The voluminous water-logged lungs i.e. ballooning of lungs creating emphysema (enlargement in lungs due to entering of water which compresses pulmonary tissues)

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[70] Kanoon, 2058 B.S. V 28 (Dr. Harihar Wasti, Autopsy: Importance and Procedure: Eight myths in medico-legal sector), P. 22

e) Presence of water in the stomach, intestine, and middle ear. If upon chemical and microscopic examination the water matches with that of water source where dead body was recovered, it is an indication that the body was drowned in the same water medium. If already dead person is thrown into water, no evidences of water lodged stomach and lungs are seen.

f) Findings of diatoms and planktons in the tissues: Diatoms are microscopic, unicellular algae with siliceous cell wall and hence are resistant to digestion, heat and putrefaction. These diatoms are found in sea water and fresh water. Only a live human body with a circulation could transport diatom to liver and other viscera and skeletal muscle. They are also found in the bile and urine. Hence, in already dead and thrown cases, diatoms cannot be detected in brain, bone marrow, liver etc. Hence, finding of diatoms in soft body tissues (viscera) suggest that the person died due to drowning. Resemblance of diatoms found in body and the source of water strongly support the ground that the same water medium was used in submersion.

Some authors maintain that drowning victims swallow much more water than they inhale.[71] At this moment, autopsy data are still inconclusive. Based on an author's (Philippe Lunetta) investigation of over 2,000 fatal drowning, the stomach of a drowning victim is either empty, or contains watery fluid, liquid mixed with food, or exclusively food. Postmortem liquid penetration into the stomach or its leakage into the small intestine impedes reliable prospective studies.

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[71] Orlowski JP, Szpilman Drowning D. Rescue, resuscitation, reanimation. Pediatr Clin North Am 48: 627– 646, 2001.

Presence of water-borne particles in the stomach, such as plankton, is also not conclusive, because they can penetrate postmortem or can be present in food and beverages consumed before the incident.[72]

In a historic *Reshamlal* case,[73] victim was found dead and floating on 7th Jestha 2013 B.S. (20 May, 1956) in Ranipokhari pond. Defendant blamed, the victim committed suicide by drowning. Government formed Board of Expert comprising seven medical practitioner for post mortem examination of the corpse to give opinion on the cause of death. The board after conducting autopsy twice reported, "though the corpse is recovered from pond, the cause of death was not drowning but from asphyxia."

The court convicted defendant for murder followed by financial transaction dispute between them. The *modus operendi* of killing was by gagging deceased with a piece of cloth at the residence of defendant, resulting into death of deceased through obstruction of breathing. With the help of other accomplices, the corpse was carried to and thrown into the pond at night and the body was found floating after 12 hours later, the next day. The defendant to simulate death as suicide, had self-inflicted bodily injuries to oneself with *khukuri* and propagated that the deceased attempted to kill him.

The case is landmark in the historical development of forensic medicine and medical jurisprudence in Nepal as it established following precedents:

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[72] Hendey NI. The diagnostic value of diatoms in cases of drowning. Med Sci Law 13: 23-34, 1973. Also see- Lunetta P, Miettinen A, Spilling K, Sajantila A. False-positive diatom test: a real challenge? A post-mortem study using standardized protocols. Leg Med 15: 229 –234, 2013. Also see- Yen LY, Jayaprakash PT. Prevalence of diatom frustules in non-vegetarian foodstuffs and its implications in interpreting identification of diatom frustules in drowning cases. Forensic Sci Int 170: 1-7, 2007. (Retrived on 08-10-2020: https://journals.physiology.org/doi/pdf/10.1152/physiol.00002.2015)

[73] *Reshamlal Makuju Shrestha* v. *Parelal Marwadi et.al.*, NKP 2017 BS, Decision Date 2017/09/15 BS, D.N. 100.

i. There are certain scientific evidences or sign that indicate death due to drowning. Presence of froth on mouth and nostrils, tightening of fits, sand and mud particles in nails, clenching of any object by fists, water ballooning of stomach, washerwoman's hands and washerwoman's foot are the evidences that indicate death due to drowning. Among all these evidences, presence of froth (might be with some blood mixture) in mouth and air passage is a confirming evidence of death by drowning. The froth even if wiped at mouth and nostril gets reappeared.

ii. It is a duty of doctor to record date and time of receipt of dead body for autopsy and the date of and time of post mortem examination of dead body.

iii. Stomach particles should be preserved during autopsy by doctor for further chemical test in case it is impossible during autopsy to identify cause of death.

iv. Suicide is an extraordinary situation committed only in case of serious mental imbalance or grievous bodily injury. No one suicides for ordinary reason.

The court explained that all the relevant information must minutely be recorded and be mentioned in detail by doctors in their report. The court took into judicial notice that many of such information have been missing in the report. Finally, directive order was issued to Ministry of Health that required Ministry to notify all the medical doctors in the country to comply with following instructions while conducting post mortem examination and filling the report:

(a) Doctors should maintain record of the date and time of receipt of dead body for autopsy and the date and time of post mortem examination in their report.

(b) In case if it becomes impossible for doctor to identify cause of during autopsy, the stomach particles should be preserved for further chemical test.

(c) Every doctor who will be conducting post mortem examinations in future, need to be attentive and clearly mention in what manner the deceased died. In doing so, the doctor must mention and record every minute matters as required under prevailing national laws and relevant literatures of medical jurisprudence.

Likewise, Supreme Court of Nepal playing guardianship role in *Mega Bahadur* case,[74] noticed that lower courts have been giving decisions blindly without properly understanding the contents of medico legal reports. The court warned subordinate courts to mandatorily understand the technical contents of post mortem examination report first, either by testifying the concerned doctor or through the help of other doctors and then only give final verdict. In this case, defendant (D/*Saadhu*) runs after in attempt to catch Victim (V/*Jaar*) in a case of adultery with intention to handover V to police for legal action. V accidentally slips down while running and falls down from high hill leading to death. Post mortem examination showed cause of death because of blood mixed water filled inside both lungs of V. Testimony of another expert doctor highlighted that blood mixed water can be filled inside human lungs even from disease like T.B., Pleuticity and so on. D was acquitted from the charge of murder.

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[74] *Megh Bahadur Pakha Rai* v. *Dalbahadur Limbu*, 2018 BS, D.N. 156.

Difference between Ante-mortem and Post-mortem Drowning

Differences	Ante mortem drowning	Post mortem drowning
Froth	Fine white leathery froth present at mouth, nose, air passage and lungs.	Absent. No forth will be developed.
Lungs	Lungs are swollen and full of water, overlap heart.	Water may be seen in lungs but not prominent in volume like in ante mortem drowning.
Cadaveric spasm	Due to struggle for life, signs of cadaveric spasm usually seen. Hands may capture weeds, grass, mud or particle contained in the bottom of lake.	No cadaveric spasm due to earlier death before submersion.
Body injuries	Usually, not present. However, injury of concussion may be seen and sometimes create confusion with ante mortem injuries hence, thorough examination of scene of crime is needed.	Ante mortem body injuries causing death are present.
Asphyxial appearance	Are present.	Not present due to death by other causes.
Diatoms	Are present in the intestine, other viscera and even brain too.	Not present because absence of respiration and blood circulation before submersion.
Motive	Suicidal, accidental and sometimes homicidal.	Homicidal. Dead body thrown in water to simulate or disguise death as accidental or suicidal and conceal crime.